Bluetooth Readers

Wirelessly Track Travel Times

The City of South Lake Tahoe had a simple question: Could Caltrans post estimated travel times on its changeable message signs to let travelers know how long it would take them to get back to the Sacramento area?

That's a question with economic implications for the local tourism economy. Visitors faced with a longer-than-usual trip might choose to stay for dinner or even overnight. It is also seen as a key piece to helping Caltrans meet its goal of improving travel time reliability and reducing peak-period travel times and delays – not just in the Sierra Nevada, but statewide. In order to improve travel time reliability, it must first be measured.

The answer was not so straightforward, at least not at first. Like many rural highways, U.S. Highway 50 in the Sierra Nevada lacks the wire loops embedded in pavement that capture travel speeds – a system common in urban areas.

The solution was Bluetooth readers, a technology first devised in Europe and used in the private sector to estimate travel times – and advanced by the Caltrans Division of Research, Innovation, and System Information (DRISI), Division of Traffic Operations, and District 3. Travelers' mobile devices and navigation systems emit signals as they travel along a highway. By capturing these signals anonymously, Caltrans can estimate travel times and post the information on the electronic changeable message signs and on QuickMap, the Caltrans mobile app that provides motorists with real-time travel conditions.

Contrary to a common misconception, Caltrans is not listening to or recording conversations and/or music transmitted over Bluetooth communications devices. The signal is picked up by a small electronic box installed at the roadside and is immediately encrypted at the site and time-stamped then sent to the host server. No personally traceable information is stored on the field unit. The host server resides within Caltrans' secure network.

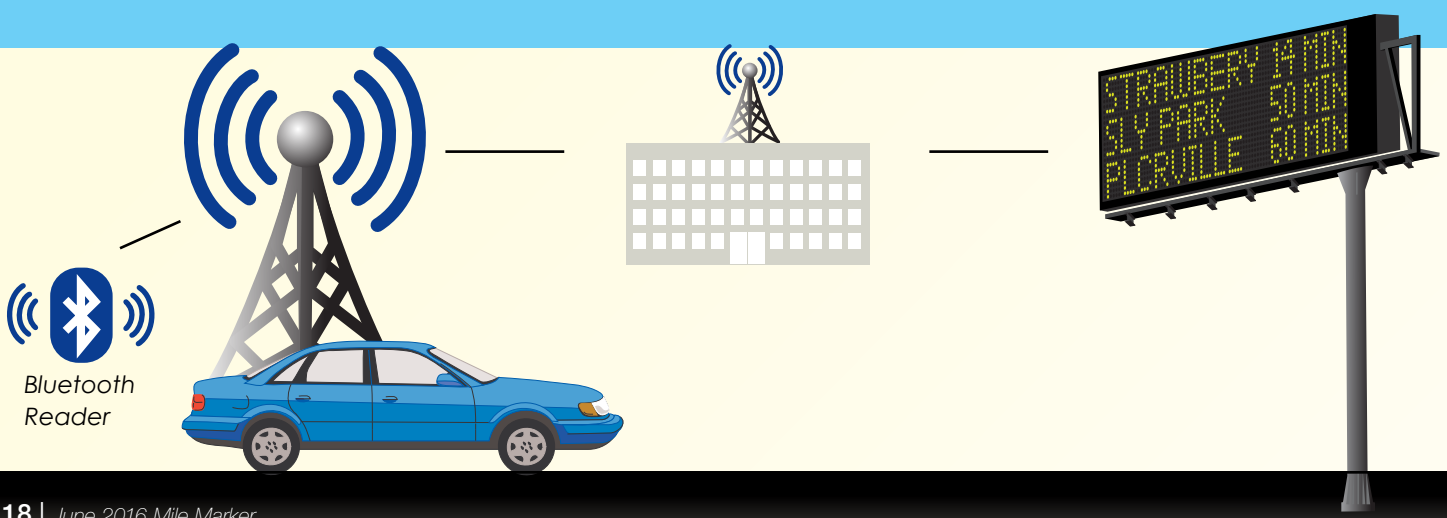
The time it takes for the matching signal to travel from the first field unit to other field units miles down the road is the travel time that is then averaged with the times provided by other vehicles.

For the South Lake Tahoe test project, Bluetooth-sensing equipment was installed at multiple locations along U.S. 50 and software was created to push the information out to QuickMap and the electronic changeable message signs. The test has been successfully running since the Fourth of July weekend in 2015. In fact, an overturned truck that weekend immediately showed the value of the system, which broadcast real-time traffic time of more than three hours between Stateline to Placerville – a distance of 60 miles — while the truck was down.

A Bluetooth listening device assigns a unique address to a passing vehicle and sends an encrypted signal to the traffic management center.

Further down, the vehicle exits the monitored section of highway and the unique address is now matched with the previous signal and a travel time calculation is made.

This information is broadcast on a changeable message sign, which can inform motorists of expected travel times.



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The locations for the Bluetooth equipment were selected based on the availability of existing power, communications, and nearby distance to roadway. Existing Intelligent Transportation System equipment cabinets were used to host the readers. The readers were initially installed by drilling a hole into the top of the cabinet to route the antenna cable, but it was feared the hole would leak over time and would cause severe damage to the electrical equipment in the cabinet. District 3 engineer Gurdeep Sidhu solved that problem by designing a side-mounted bracket that uses the existing cabinet hardware to secure the new bracket, reducing the chance for leakage and reducing the materials and time required to mount the antenna from two hours to 20 minutes.

Quantifying the Benefits

It is difficult to quantify the benefits of posting travel times on changeable message signs, as it is challenging to determine what decisions drivers make when they view them. Qualitatively, on corridors that drivers travel regularly, seeing the posted travel time gives them "peace of mind" that their trip will be reliable. For example, if the posted travel time on the corridor is normally 19 minutes, but today it is 38 minutes, then drivers can be sure that something unusual has occurred.

On corridors where there are alternative routes or modes, drivers could decide to change their travel plans. They could also decide to stop their trip and wait until traffic conditions improve. With these options, drivers help to self-manage the demand on the transportation system, which helps the system operate better. An informed traveler can be a safer and more efficient traveler.

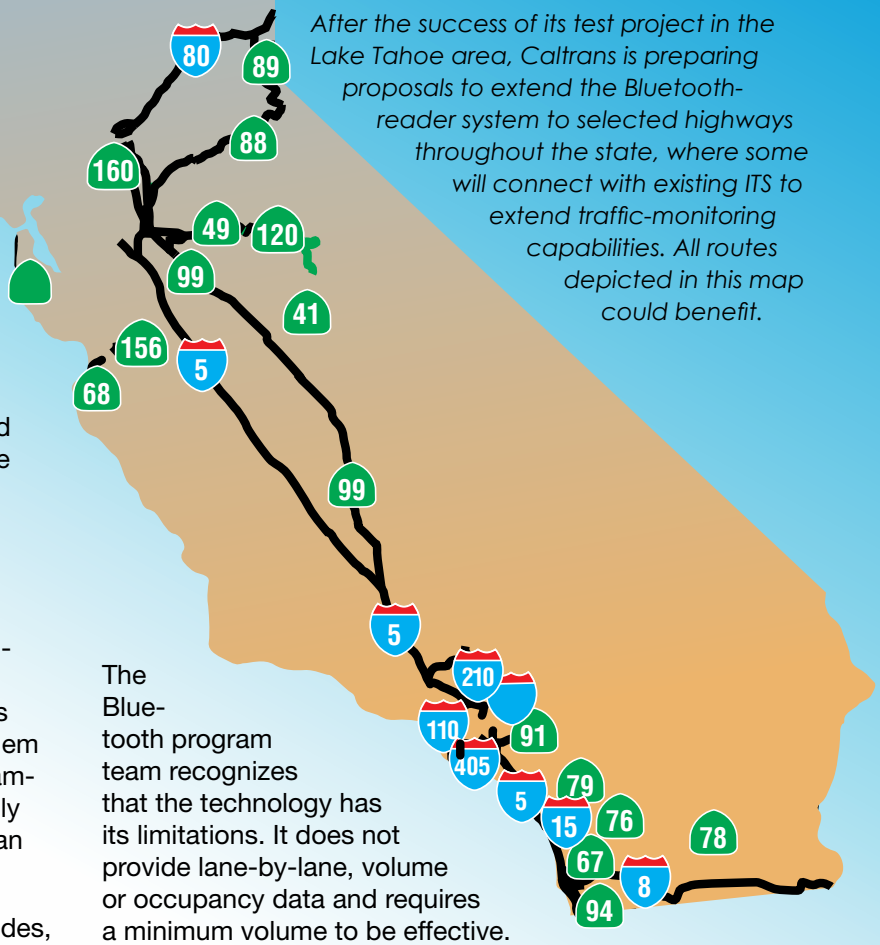
What's Next?

Caltrans thinks the system shows promise. It helps motorists, improves system performance and costs relatively little. Total cost for the U.S. 50 test project was about $150,000, including labor and materials. Initial deployment around the state is estimated to cost about $20 million. Money would come from the State Highway Operation and Protection Program. Proposals are already being prepared.

The Tahoe project, for example, would eventually be connected to State Route 89 north to Interstate 80, then west toward the Bay Area. Various routes through the Central Valley would also be connected, all the way down through southern California and along Interstate 8 near the Mexican border.

Possible Routes for Bluetooth Readers

After the success of its test project in the Lake Tahoe area, Caltrans is preparing proposals to extend the Bluetooth-reader system to selected highways throughout the state, where some will connect with existing ITS to extend traffic-monitoring capabilities. All routes depicted in this map could benefit.



The Bluetooth program team recognizes that the technology has its limitations. It does not provide lane-by-lane, volume or occupancy data and requires a minimum volume to be effective. Also, some devices might be able to block Bluetooth transmissions or can simply be turned off by its user.

Research is now being conducted to determine whether Wi-Fi might be an effective work-around. It is acknowledged that future technologies might make both obsolete, but proving that travel-time data could be obtained wirelessly would ensure that the program will have lasting value.

South Lake Tahoe is Already Reaping the Rewards

"We are thrilled with the posted times and information provided to the traveling public," said South Lake Tahoe City Manager Nancy Kerry. "We have encouraged the lodging properties to link to the posting signs and times on the Caltrans website (www.TahoeRoads.com). Now it's a matter of getting the information to the traveling public to encourage them to stay longer, or leave earlier or watch the traffic and adjust their stay accordingly."

Source: Caltrans Division of Traffic Operations and Division of Research, Innovation and System Information